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Poly(benzimidazole)–functionalized graphene supported Pt electrocatalyst and its application in high temperature PEM fuel cells

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It is widely known that the performance and durability of PEM fuel cells are strongly dependent on the catalyst support structure and properties [1-2]. In order to enhance the catalytic activity, increase the utilization of Pt-based catalysts and thus lower the costs, highly stable supports with large surface areas for the efficient dispersion of Pt nanoparticles are required.

Due to its high surface area and excellent electronic conductivity, *graphene* has attracted great attention as mechanically and thermally stable and durable as a 2-D support. Graphene has a greater surface area than carbon nanotubes (CNTs) which are among the most efficient carbon supports [2]. Similar to CNTs, graphene requires an investigation into the chemical functionalization methods needed to obtain high dispersion and homogeneous loading of Pt nanoparticles on the surface. Recently, it was found that poly(benzimidazole) (PBI) can act as Pt nanoparticle adsorbent for PBI-wrapped CNTs [3]. PBI wrapping leads to more efficient Pt loading, possibly due to the formation of the so called triple-phase boundary nanostructures formed between CNTs, aromatic nitrogen incorporated in the PBI structure, and Pt nanoparticles.

In this study, we have systematically investigated the effects of the PBI-functionalized graphene as a support for Pt-based electrocatalyst (Pt/Graphene-PBI). Graphene/PBI composites were prepared by adding graphene to a PBI/DMAc solution with subsequent sonication, filtration, washing out undoped PBI with DMAc and drying under vacuum [3]. Pt supported on graphene/PBI composites (Pt/graphene-PBI) were prepared from platinum nanoclusters in organic media as described in the literature [4]. The transmission electron microscope (TEM) image [**Figure 1**] shows the uniform Pt particles distribution on the PBI functionalized graphene sheet, with narrow (lower than 2 nm) particle size.

The clear evidence of PBI functionalized graphene was detected by FTIR spectroscopy [**Figure 2**].

The efficiency potential of Pt/Graphene-PBI as a catalyst for oxygen reduction reaction (ORR) and its stability/durability will be presented.

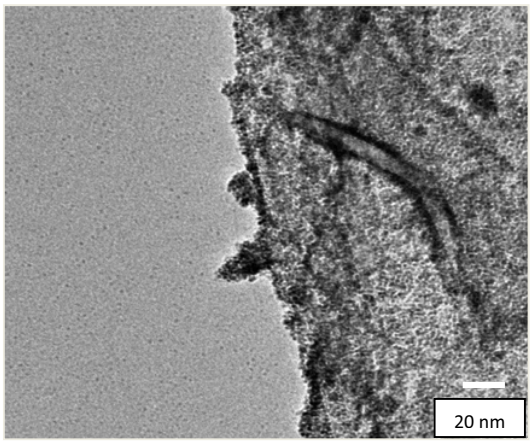

Figure 1. TEM image of 40% Pt/graphene-PBI catalyst.

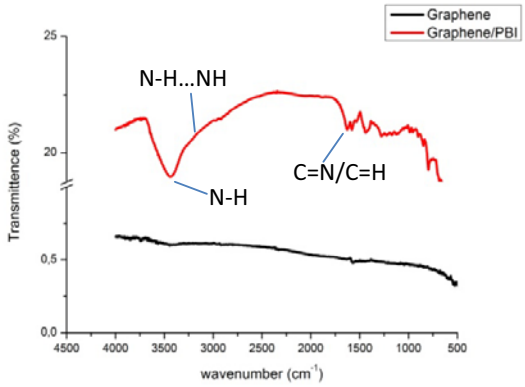

Figure 2. FTIR spectra of un-functionilized graphene (black line) and PBI-functionalized graphene (red line).

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